WORKPIECE CONFIGURATION DETECTION SYSTEM AND METHOD

RELATED APPLICATION

[00001] The subject patent application claims priority to all the benefits of U.S. Provisional Patent Application Serial No. 60/456,493, filed on March 21, 2003.

FIELD OF THE INVENTION

[00002] This invention relates generally to a system and method for measurement of a workpiece, and more particularly to a system and method for automated identification and measurement of rotary members such as tires for motor vehicle.

BACKGROUND OF THE INVENTION

[00003] Manual identification, measurement of various dimensions and orientation of mounted units, i.e. wheel and tire assembly for motor vehicle can be time consuming and subject to human error. It has become desirable to process an ever-increasing variety of the wheels and tires, through a single assembly line. Modern assembly lines for production and processing of the wheel and tire assembly for motor vehicles are automated to provide maximum production efficiency. With the advent of flexible manufacturing and the multiplicity of different styles, configurations and dimensions of the wheel and tire assembly, the automated assembly line has become more desirable and efficient.

[00004] Typically, the automated assembly line for mounted units includes a conveyor base to accommodate various work-stations. These stations include a wheel, i.e. wheel loader assembly designed to position the wheel on a wheel plate operably connected to the conveyor, a wheel soaper assembly for applying a lubricant solution onto

the edges of the wheel, wherein the wheel soaper assembly is attached to the wheel loader assembly. A tire soaper assembly for applying the lubricant around inner circumference of the tire before mounting the tire about the wheel to form the wheel is also provided at the assembly line. Generally, the assembly line includes wheel and tire mounting and tire inflation assemblies.

[00005] In order to process multiple varieties of the wheel and tire assemblies through the single assembly line, it has become necessary to verify the type of the wheel entering an assembly process so that mechanized assembly devices can assemble the correct components. For example, it has become desirable to mate up to six consecutive wheel sizes with corresponding tires at an assembly facility. To match the correct tire with the correct wheel size and to identify the correct valve stem to be inserted into a given wheel, each wheel must be identified upon entering the assembly process and the various mechanized assembly stages must be signaled which wheel size is to be processed. Because four tires and wheels must be assembled for each vehicle, each wheel or tire entering the assembly line must be identified within a matter of seconds.

[00006] The art is replete with various workstations using laser beams and light sources for identifying and orienting various workpieces and parts. The United States Patent Application Publication No. 200300665421 to Didriksen et al. teaches a storage system for receiving, delivering and storing items to be distributed. The size of the items is determined in order to allocate the correct amount of space. The system includes a cylindrical shell part that comprises nine photocells being positioned in a vertical direction. Thus, the height of an item being received by the system and positioned on a platform, is determined by blocking one or more of the photocells.

[00007] The United States Patent No. 6,173,213 to Amiguet et al. teaches a system for identifying and orienting a wheel. The system includes a wheel style recognition station, a conveyor for delivering the wheel to the wheel style recognition station, and a wheel orientation sensor that senses the radial orientation of the wheel on the wheel style recognition station, and generates a radial orientation signal. The system includes a wheel-mapping sensor that scans the wheel and generates a wheel style mapping signal pattern, while the wheel is rotated at a steady rate of rotation. The system also includes a control unit, which compares the wheel style mapping signal pattern with at least one reference wheel style mapping signal pattern. These systems have proven to be too slow to evaluate a large number of variously sized wheels and tires.

[00008] Other presently known wheel identification stations have utilized video cameras in an attempt to identify a given wheel size. These video identification devices signal a controller, which requires a significant amount of processing to make correct wheel identification. This type of identification device requires a significant amount of computing power to identify wheels at a rapid pace, which has resulted in an excess of cost to produce a wheel identification assembly line.

[00009] There is a constant need in the area of the automotive industry for an improved system for and a method of determining a configuration of a workpiece at ever increased speed.

SUMMARY OF THE INVENTION

[00010] An assembly for determining the configuration of a workpiece, such as, for example a tire, includes a platform having a longitudinal axis for supporting and moving the tire along the longitudinal axis. A first detection assembly transmits a first signal around the tire in the direction transverse to the longitudinal axis. The first

detection assembly receives the transmitted first signal passed around the tire. The first detection assembly is operably connected to a controller. The controller evaluates the first signal received from the first detection assembly thereby determining a first configuration, i.e. heights, of the tire. A second detection assembly transmits a second signal around the tire in the direction transverse to the direction of the first signal. The second detection assembly receives the transmitted second signal around and the tire. The second detection assembly is operably connected to the controller for determining a second configuration, i.e. outer and inner diameters of the tire. The controller integrates the first and second signals for determining a third, i.e. three-dimensional configuration of the tire, thereby identifying the tire being evaluated.

[00011] A method of present invention includes the step of orienting the first detection assembly with respect to the platform and transmitting the first signal from the first detection assembly onto the tire in the direction transverse to the platform. The method includes the step of receiving the transmitted first signal around the tire by the first detection assembly. The following step of the method includes evaluating the first signal received from the first detection assembly to determine the first configuration of the part. The next step includes orienting the second detection assembly with respect to the platform followed by transmitting the second signal from the second detection assembly onto the tire in the direction transverse to the direction of the first signal. The method includes receiving the transmitted second signal by the second detection assembly around the tire and evaluating the second signal received from the second detection assembly to determine the second configuration of the tire. The method includes integrating the signals to determine the third, three-dimensional configuration of the tire, thereby identifying the part being evaluated.

[00012] An advantage of the present invention is to provide an assembly for and method of identifying the type of workpiece entering an assembly process by virtue of integrating two-dimensional signals for determining three-dimensional configuration of the tire. This has enabled the rapid detection of the size and shape of the tire allowing an increase in the variety of tires being detected while maintaining high production volumes.

BRIEF DESCRIPTION OF THE DRAWINGS

[00013] Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[00014] Figure 1 shows a front view of a workpiece configuration detection assembly;

[00015] Figure 2 shows a partial plan view of the workpiece configuration detection assembly;

[00016] Figure 3 shows a top view of the workpiece configuration detection assembly; and

[00017] Figure 4 shows a conveyance device for receiving the workpiece from the workpiece configuration detection assembly and transferring the workpiece to an assembly line.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[00018] An assembly for determining the configuration of a workpiece of the present invention is generally shown at **10** in Figures 1 through 3. The workpiece

includes tires, wheels or any other component being processed through an assembly line, hereinafter, referred to as a tire and shown at **12**.

[00019] The assembly **10** includes a platform, generally indicated at **14**, having a longitudinal axis **A,** as shown in Figure 3, for supporting and moving the tire **12** along the longitudinal axis **A**. A first detection assembly, generally indicated at **16** transmits a first signal around the tire **12** in the direction transverse to the longitudinal axis A. The first detection assembly **16** receives the transmitted first signal passed around the tire **12**. The first detection assembly **16** is operably connected to a controller **18**. The controller **18** evaluates the first signal received from the first detection assembly **16** thereby determining a first configuration, i.e. heights, of the tire **12**. A second detection assembly, generally indicated at **20**, transmits a second signal around the tire **12** in the direction transverse to the direction of the first signal. The second detection assembly **20** receives the transmitted second signal around the tire **12**. The second detection assembly **20** is operably connected to the controller **18** for determining a second configuration, i.e. outer and inner diameters of the tire **12**. The controller **18** integrates the first and second signals for determining a third, i.e. three-dimensional configuration of the tire **12**, thereby identifying the tire **12** being evaluated. The controller **18** includes a comparative program for determining the three dimensional configuration of the tire **12** from the first and second configurations.

[00020] The platform **14** includes a frame **22** having side walls **24**, **26** and terminal ends **28**, **30**. The side walls **24**, **26** of the platform **14** include a plurality of rollers, i.e. roller bars **32**, which are pivotally supported between the side walls **24**, **26**. The roller bars **32** are spaced one from the other for supporting the tire **12** being transferred therethrough. While roller and belt type of conveyor platforms may be

employed, both being well known to those skilled in the art, only the roller type conveyor platform **14** configuration has been described. Hence, the roller type conveyor platform **14** configuration used in the workpiece configuration detection system **10** is not intended to limit the present invention.

[00021] The first detection assembly **16** includes a light emitter **34** for transmitting the first signal, i.e. light, and a light receiver **36** for receiving the first signal. The light emitter **34** and receiver **36** of the first detection assembly **16** are spaced one from the other and connected to the side walls **24**, **26**, respectively, by a support mount, generally shown at **38** in Figure 1 and discussed further below. The light emitter **34** and light receiver **36** of the first detection assembly **16** include a length greater than the largest height of the tire **12** being transferred through the platform **14**.

[00022] The second detection assembly **20** also includes a light emitter **40** and a light receiver **42** for transmitting and receiving the second signal, i.e. light. The light emitter **40** and receiver **42** of the second assembly **20** are operably connected to the support mount **38** and are spaced from one and the other by the light emitter **34** and receiver **36** of the first detection assembly **16**, wherein the light emitter **40** is positioned above the platform **14** and the light receiver **42** is positioned beneath the platform **14**. The light emitter **40** and light receiver **42** of the second detection assembly **20** include a length greater than the largest diameter of the tire **12** being transferred through the platform **14**.

[00023] The light emitters **34**, **40** of the first **16** and second **20** detection assemblies include a plurality of light emitting sources (not shown) grouped one with the other. The light receivers **36**, **42** of the first **16** and second **20** detection assemblies include a plurality of light absorbing sources, i.e. silicone photodiodes, (not shown) grouped one with the other and aligned with respect to complementary light emitting

sources. Preferably, each light receiver **36**, **42** is a beam array receiver, which detects the transmission of light at a given location along the light receivers **36, 42**. For example, by blocking a transmission of light to a particular area, the beam array receivers, i.e. the light receivers **36**, **42** generate a signal that distinguishes the area that receives the transmitted light arrays and the area that does not receive the transmitted light rays, i.e., light vs. dark. By distinguishing light vs. dark, the light receivers **36**, **42** generate a signal representing the basic outline of the tire **12**, such as, for example the inside and outside diameters and the height of the tire **12**. Hence, the orientation of the plurality of light absorbing sources, grouped one with the other and aligned with respect to the complementary light emitting sources used in the workpiece configuration detection system **10** is not intended to limit the present invention.

[00024] Referring again to Figures 2 and 3, the support mount **38** is positioned at the terminal end **28** of the platform **14** for supporting and for orienting the first **16** and second **20** detection assemblies around the platform **14**. The support mount **38** includes upper section, generally indicated at **46**, and lower section, generally indicated at **48**. The upper section **46** defined by a pair of vertical support beams **50**, **52** for vertical orientation of the light emitter **34** and receiver **36** of the first detection assembly **16**, having terminal ends and spaced one from the other and connected to the frame **14** at one of the terminal ends, respectively. The upper section **46** includes a horizontal support beam **54** supported by and disposed between the vertical support beams **50**, **52**. The horizontal beam **54** of the upper section **46** is designed for horizontal orientation of the light emitter **40** of the second detection assembly **20**. The light emitter **34** and light receiver **36** of the first detection assembly **16** are connected to the vertical support beams **50**, **52** of the upper section **46**, respectively. The light emitter **40** of the

second detection assembly **20** is connected to the horizontal support beam **54** of the upper section **46**.

[00025] The lower section **48** includes a pair of vertical support beams **60**, **62** having terminal ends and being spaced one from the other and connected to the frame **14**. A horizontal support beam **64** of the lower section **48** is supported by and disposed between the vertical support beams **60**, **62** of the lower section **48** and between the roller bars **32**. Similar to the horizontal beam **54** of the upper section **46**, the horizontal beam **64** of the lower section **48** is designed for horizontal orientation of the light receiver **42** of the second detection assembly **20**.

[00026] A method of determining the configuration of the tire **12** of present invention is now being discussed. The method includes the step of orienting the first detection assembly **16** with respect to the platform **14** to transmit the first signal from the light emitter **34** of the first detection assembly **16** onto the tire **12** in the direction transverse to the longitudinal axis **A** of the platform **14**. The next step of the method includes receiving the transmitted first signal around and through the tire **12** by the light receiver **36** of the first detection assembly **16**. The following step includes evaluating the first signal received from the first detection assembly **16** to determine the heights of the tire **12**.

[00027] The next step of the method includes orienting the second detection assembly **20** with respect to the platform **14** followed by transmitting the second signal from the second detection assembly **20** onto the tire **12** in the direction transverse to the direction of the first signal. The method includes receiving the transmitted second signal by the second detection assembly **20** around and through the tire **12** and evaluating the second signal received from the second detection assembly **20**

to determine the inner and outer diameters of the tire **12**. The method includes integrating the signals to determine the three dimensional configuration of the tire **12** thereby identifying the tire **12** being evaluated

[00028] During operation, the tire **12** passes through the support mount **38** supporting the light emitters **34, 40** and the light receivers **36, 42**. As the tire **12** passes the support mount **38**, light transmitted from the emitter **40** is blocked by the tire **12** and therefore does not reach the light receiver **42**. By virtue of the blocked light arrays, the light receiver **42** generates the second signal to the controller **18** so that the controller **18** can determine the inside and outside diameters of the tire **12** passing through the support mount **38**. In a similar fashion, light arrays generated by the light emitter **34** is blocked by the tire **12** so that only a fraction of the light generated by the light emitter **34** reaches the light receiver **36**. The light receiver **36** transmits the first signal based upon the light blocked from the light emitter **34** to the controller **18** so that the controller **18** can determine the height of the tire **12** passing through the support mount **38**. A conveyance device generally shown at **70** in Figure 3, receives the tire **12** from a prior stage such as, for example, a tire soaper (not shown), and transfers the tire **12** into an assembly line (not shown). A cylinder **72** or an equivalent orients the conveyance device **70** so that the tire **12** derives motion and is propelled across the roller bars **32** disposed in the platform **14**.

[00029] The controller **18** is pre-programmed with inside diameters, outside diameters, and height of the various tire **12** sizes being processed so that the controller **18** can identify which tire **12** is passing through the support mount **38** and signals subsequent work stations **80**, **82**, such as, for example a wheel soaper station and a wheel loader station, respectively, with the type of tire **12** entering the assembly process. By signaling the subsequent work stations **80, 82**, the appropriate wheel (not

shown) can be mated with each tire **12** passing through the platform **14** in the absence of the processing error that results in matching the correct wheel with the correct tire **12**.

[00030] While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.